CLAIMS

[1] A session relay apparatus for performing session relay processing including congestion control processing and packet delivery control processing on a plurality of layers, characterized in that:

each of the plurality of layers only creates the congestion control information, and the packet delivery control processing is concentrated in a scheduler on an IP (Internet Protocol) layer.

[2] The session relay apparatus according to claim 1, wherein reception buffers and transmission buffers corresponding to the plurality of layers are concentrated in a transmission buffer corresponding to the IP layer.

[3] A session relay apparatus for realizing communication between a reception terminal and a transmission terminal by relaying data between a session to said transmission terminal and a session to said reception terminal, characterized by comprising:

reception session processing means for receiving data from the session to said transmission terminal;

transmission session processing means for transmitting data to the session to said reception terminal;

a transmission buffer for temporarily storing data delivered to said transmission terminal;

a packet scheduler for controlling a packet delivery from said transmission buffer; and

delivery control means for controlling the delivery of data

stored in said transmission buffer in response to the control of said packet scheduler,

wherein said transmission session processing means calculates the amount of data which is permitted to be delivered on the layer, and said packet scheduler controls the packet delivery based thereon.

[4] The session relay apparatus according to claim 3, wherein:

said reception session processing means performs reception processing for data from a TCP (Transmission Control Protocol) session,

said transmission session processing means processes data for delivery to the TCP session, and notifies said packet scheduler of the amount of data which can be delivered, as determined by TCP window flow control, and

said packet scheduler performs scheduling processing based on the notified amount of data.

[5] The session relay apparatus according to claim 3, wherein said packet scheduler determines a session in which a packet is delivered based on a communication resource allocation policy including at least a bandwidth and a bandwidth ratio allocated to the session, the amount of transmissible data notified from said transmission session processing means, and the amount of data stored in said transmission buffer, to control the data delivery from each of the sessions.

[6] The session relay apparatus according to claim 3, wherein

said packet scheduler further comprises accumulating means for accumulating unused communication resources in each of the sessions, and makes communication using the communication resources accumulated in said accumulating means when the communication resources are required.

[7] The session relay apparatus according to claim 6, wherein said transmission buffer contains data to be delivered, and said packet scheduler accumulates only a bandwidth of the communication resources rendered free by a restriction on the amount of delivery permitted data from said delivery control means.

[8] The session relay apparatus according to claim 3, further comprising means for dynamically changing a control parameter of the transmission session, wherein the control parameter is changed in accordance with a data delivery situation from said packet scheduler.

[9] The session relay apparatus according to claim 8, wherein the control parameter of the session is changed in a direction in which an output bandwidth from the session decreases when a free bandwidth of the session increases, the control parameter of the session is changed in a direction in which the output bandwidth from the session increases when the free bandwidth of the session decreases, and the change of the control parameter is stopped when congestion is caused by a change in the control parameter.

[10] The session relay apparatus according to claim 9, further comprising means for dynamically changing the amount of allocated communication resources including at least a bandwidth and a

bandwidth ratio allocated to each of the sessions,

wherein the control parameter is changed in accordance with a data delivery situation from said packet scheduler and the amount of data available for communication notified from said delivery control means.

[11] The session relay apparatus according to claim 10, wherein resources allocated to the session are reduced when the free bandwidth of the session increases, the resources allocated to the session are increased with its initial value defined as an upper limit when the free bandwidth of the session decreases, and the allocated resources are increased or decreased in accordance with the amount of transmissible data notified from said delivery control means or an average thereof.

[12] The session relay apparatus according to claim 3, including transmission rate control means for controlling transmission control information including at least a bandwidth, availability of transmission, and the amount of transmissible data for controlling transmission processing for a session from said transmission terminal, wherein the transmission control information to said transmission terminal is changed or generated in accordance with the free capacity of said transmission buffer and information from said packet scheduler.

[13] The session relay apparatus according to claim 12, further comprising means for receiving packet delivery information from said packet scheduler, and means for checking said transmission buffer for the free capacity changed by a delivered packet, wherein

a dispatch confirmation packet is transmitted to said transmission terminal to prompt the same to resume a transmission when the free capacity of said transmission buffer increases to a certain amount or more after a packet has been delivered.

[14] The session relay apparatus according to claim 12, further comprising means for examining at least one of the free capacity of said transmission buffer and an average thereof, wherein said transmission terminal is instructed to reduce a transmission bandwidth in accordance with the free capacity.

[15] A session relay apparatus for realizing a communication between a transmission terminal and a reception terminal by relaying data between a session to said transmission terminal and a session to said reception terminal, characterized by comprising:

reception session processing means provided in correspondence to a plurality of layers for receiving data from the session to said transmission terminal;

transmission session processing means provided in correspondence with the plurality of layers for transmitting data to the session to said reception terminal;

a transmission buffer for temporarily storing data delivered to said transmission terminal; and

a packet scheduler for controlling the delivery of packets from said transmission buffer,

wherein each of said transmission session control means calculates the amount of data permitted to be delivered on an associated layer, and said packet scheduler controls the packet

delivery based on the amount of data permitted in common on all of the plurality of layers.

[16] The session relay apparatus according to claim 15, wherein said layers include an iSCSI (internet Small Computer System Interface) layer as one of the layers for conducting congestion control, and the amount of transmissible data is determined on the basis of the amount of receivable data received from said reception terminal on the iSCSI layer.

[17] The session relay apparatus according to claim 15, further comprising:

means for receiving packet delivery information from said packet scheduler; and

means for checking said transmission buffer for a free capacity changed by a delivered packet,

wherein the amount of receivable data is generated for said transmission terminal to prompt the same to resume a transmission when the free capacity of said transmission buffer increases to a certain amount or more after a packet has been delivered.

[18] The session relay apparatus according to claim 3, wherein said reception session processing means directly stores a received packet in said transmission buffer, and directly delivers the packet from said transmission buffer.

[19] The session relay apparatus according to claim 3, wherein data is written from an application program into said transmission buffer, and received data is passed to the application program.

[20] A session relaying method for a session relay apparatus for performing session relay processing including congestion control processing and packet delivery control processing on a plurality of layers, characterized in that:

each of the plurality of layers only creates the congestion control information, and the packet delivery control processing is concentrated in a scheduler on an IP (Internet Protocol) layer scheduler.

[21] 21. The session relaying method according to claim 20, wherein a reception buffer and a transmission buffer corresponding to the plurality of layers are concentrated in a transmission buffer corresponding to the IP layer.

[22] A session relaying method for a session relay apparatus for realizing a communication between a reception terminal and a transmission terminal by relaying data between a session to said transmission terminal and a session to said reception terminal, characterized by comprising, on said session relay apparatus side:

a reception session step of receiving data from the session to said transmission terminal;

a transmission session step of transmitting data to the session to said reception terminal;

a step of temporarily storing data delivered to said transmission terminal in a transmission buffer;

a step of controlling a packet delivery from said transmission buffer in a packet scheduler; and

a step of controlling the delivery of data stored in said

transmission buffer in response to the control of said packet scheduler in delivery control means,

wherein said transmission session processing calculates the amount of data which is permitted to be delivered on the layer, and said packet scheduler controls the packet delivery based thereon.

[23] The session relaying method according to claim 22, comprising a step for performing reception processing for data from a TCP (Transmission Control Protocol) session,

wherein said transmission session step processes data for delivery to the TCP session, and notifies said packet scheduler of the amount of data which can be delivered, as determined by TCP window flow control, whereby said packet scheduler performs scheduling processing based on the notified amount of data.

[24] The session relaying method according to claim 22, further comprising the step of determining a session in which a packet is delivered, by said packet scheduler, based on a communication resource allocation policy including at least a bandwidth and a bandwidth ratio allocated to the session, the amount of transmissible data notified from said transmission session processing means, and the amount of data stored in said transmission buffer, to control the data delivery from each of the sessions.

[25] The session relaying method according to any of claim 22, wherein said packet scheduler further comprises accumulating means for accumulating unused communication resources in each

of the sessions, and

said method further comprising the step of making a communication using the communication resources accumulated in said accumulating means when the communication resources are required in said packet scheduler.

[26] The session relaying method according to claim 25, further comprising the step of accumulating, by said packet scheduler, only a bandwidth of the communication resources rendered free by a restriction on the amount of delivery permitted data from said delivery control means, wherein said transmission buffer contains data to be delivered.

[27] The session relaying method according to claim 22, further comprising the step of changing a control parameter of the transmission session in accordance with a data delivery situation from said packet scheduler by means for dynamically changing the control parameter.

[28] The session relaying method according to claim 27, further comprising the step of changing the control parameter of the session in a direction in which an output bandwidth from the session decreases when a free bandwidth of the session increases, changing the control parameter of the session in a direction in which the output bandwidth from the session increases when the free bandwidth of the session decreases, and stopping the change of the control parameter when a congestion is caused by a change in the control parameter.

[29] The session relaying method according to claim 28, further

comprising the step of changing the control parameter in accordance with a data delivery situation from said packet scheduler and the amount of data available for communication notified from said delivery control means by means for dynamically changing the amount of allocated communication resources including at least a bandwidth and a bandwidth ratio allocated to each of the sessions.

[30] The session relaying method according to claim 29, further comprising the step of reducing resources allocated to the session when the free bandwidth of the session increases, increasing the resources allocated to the session with its initial value defined as an upper limit when the free bandwidth of the session decreases, and increasing or decreasing the allocated resources in accordance with the amount of transmissible data notified from said delivery control means or an average thereof.

[31] The session relaying method according to any of claims 22 to 29, further comprising the step of changing or generating the transmission control information to said transmission terminal in accordance with the free capacity of said transmission buffer and information from said packet scheduler by transmission rate control means for controlling transmission control information including at least a bandwidth, availability of transmission, and the amount of transmissible data for controlling transmission processing for a session from said transmission terminal.

[32] The session relaying method according to claim 31, further comprising the step of transmitting a dispatch confirmation packet

to said transmission terminal to prompt the same to resume a transmission when the free capacity of said transmission buffer increases to a certain amount or more after a packet has been delivered.

[33] The session relaying method according to claim 31, further comprising the step of instructing said transmission terminal to reduce a transmission bandwidth in accordance with a free capacity examined by means for examining at least one of the free capacity of said transmission buffer and an average thereof.

[34] A session relaying method for a session relay apparatus for realizing a communication between a transmission terminal and a reception terminal by relaying data between a session to said transmission terminal and a session to said reception terminal, characterized by comprising, on said session relay apparatus side:

a reception session step of receiving data from the session to said transmission terminal in each of a plurality of layers;

a transmission session step of transmitting data to the session to said reception terminal in each of the plurality of layers;

a step of temporarily storing data delivered to said transmission terminal in a transmission buffer; and

a step of controlling the delivery of packets from said transmission buffer in a packet scheduler,

wherein the amount of data permitted to be delivered on an associated layer is calculated in each of the transmission session processing, and said packet scheduler controls the packet delivery based on the amount of data permitted in common on all of

the plurality of layers.

[35] The session relaying method according to claim 34, wherein said layers include an iSCSI (internet Small Computer System Interface) layer as one of layers for conducting congestion control, and said method further comprises the step of determining the amount of transmissible data on the basis of the amount of receivable data received from said reception terminal on the iSCSI layer.

[36] The session relaying method according to claim 34, further comprising the step of generating the amount of receivable data for said transmission terminal to prompt the same to resume a transmission when the free capacity of said transmission buffer increases to a certain amount or more after a packet has been delivered.

[37] The session relaying method according to claim 22, wherein said reception session step further comprises the step of directly storing a received packet in said transmission buffer, and directly delivering the packet from said transmission buffer.

[38] The session relaying method according to claim 22, further comprising the step of writing data from an application program into said transmission buffer, and passing received data to the application program.